ROTATION SUPPORT OF HEAT-DISSIPATION FAN

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CROSS REFERENCE TO RELATED APPLICATION

U.S. PATENT DOCUMENTS

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an improved structure of rotation support of heat-dissipation fan, wherein ceramic bearing is fixed on rotor and rotates with rotor, various ceramic axle tube supporting structures are provided and interior and exterior surface of bearing and axle tube are further processed to lower rotational friction thereof achieve lower noise, lower power consumption, longer life and higher speed.

2. Description of the Prior Art

FIG.1 is an exploded view of prior art heat-dissipation fan. The axial shaft 101 is fixed on rotor 100 at one end and surrounded by axle tube 102 with either ball

bearing 103 or metal sleeve 104 supports. When stator coil 105 is energized to generate impelling magnetic force, the circular permanent magnet installed inside rotor 100 will act upon the magnetic force and rotate the rotor. The ball bearing 103 or metal sleeve 104 is key component to fan rotation in prior art. Ball bearing 103 has lower friction and longer life but when dust or debris goes into ball bearing, the bearing function rapidly deteriorate generating vibration, abnormal heat and loud noise and become unusable. In addition, the price of ball bearing is among the highest compared with other solutions. The metal sleeve 104 is cheap but wears out very quick which require regular maintenance check and replacement. When lubricant of these prior art is consumed, abnormal heat and friction will greatly shorten the life of prior art fan.

In addition, axial shaft 101 is fixed on rotor and rotate with rotor while metal sleeve 104 is fixed on fan base and do not rotate, the friction caused by whole surface contact between them and viscosity of lubricant will offset impelling force create by magnetic force, resulting high heat, high friction, lower rotor speed and wasting of energy.

SUMMARY OF INVENTION

Accordingly, the object of the present invention is to provide an improved structure of rotation support of heat-dissipation fan to achieve lower rotational friction, lower noise, lower power consumption, longer life and higher speed.

In order to achieve above objectives, the present invention provides an improved structure comprising ceramic hollow bearing passing thru and fixed on

rotor and rotate with rotor, ceramic hollow or solid axle tube passing through the inside of bearing and rotate freely or fixed to fan body to provide low friction and high speed rotation. Exterior surface of bearing is formed or ground to provide better connection with rotor while interior of bearing and exterior of axle tube are further processed to reduce surface contact area thereof lower rotational friction.

The first preferred embodiment of the present invention comprising a ceramic hollow tube shape bearing, support bearing and axle tube and a ceramic holding ring. The bearing passes through and fix on fan rotor and rotate with the rotor while the support bearing fixes on fan base and work as structural support, which do not rotate. The axle tube is cylindrical shape or with an end flange portion forming a T shape tube and the axle tube pass through the inside of bearing and support bearing and rotate asynchronously and freely with fan rotor. The axle tube functions as structural support, providing multi-point contact rotating support mechanism. The ceramic holding ring has an opening gap and is installed at one end of axle tube to limit the axial movement of axle tube.

When the heat-dissipation fan is energized and in rotation, the bearing is rotating with the rotor and the axle tube will be carried forward asynchronously and rotating slowly within the bearing. Since the bearing and axle tube are rotating at different speeds in the same direction, it will greatly reduce friction and increase fan speed and efficiency. To avoid axial direction movement of axle tube, a ceramic holding ring is installed at the end of axle tube. Rotating bearing, fixed support bearing, free moving axle tube and auto balancing of magnetic force will create a very stable high speed multi-point contact rotating support

mechanism with minimum vibration and friction.

The bearing and support bearing are ceramic hollow tubes, the exterior of bearing and support bearing are formed or ground to concave surface with smaller outer diameter or non-circular shape or concave groove shape to provide a simple but solid connection with fan rotor body and is suitable for mass production of embedded injection molding of fan rotor body. The interior of bearing and support bearing are formed or ground with concave grooves to further reduce surface contact surface and friction among bearing, support bearing and axle tube.

The axle tube is solid or hollow ceramic tube with cylindrical shape or with an end flange portion forming a T shape, the exterior of axle tube is formed or ground with concave grooves or with non-circular shape to further reduce surface contact surface and friction among bearing, support bearing and axle tube.

In addition, the gap between bearing/support bearing and axle tube is kept below 10 μm to avoid rotation vibration and noise.

The second preferred embodiment of the present invention comprising a ceramic hollow tube shape bearing and axle tube and a ceramic holding ring. The bearing passes through and fixes on fan rotor and rotating with the rotor. The axle tube is cylindrical shape or with an end flange portion forming a T shape tube and the axle tube pass through the inside of bearing and fixed on fan base to provide structural support and multi-point contact rotating support mechanism. The ceramic holding ring has an opening gap and is installed at one end of axle tube to limit the axial movement of axle tube. As stated in the first preferred

embodiment of present invention, the interior of bearing and exterior of axle tube can be further processed to reduce surface contact and friction and the exterior of bearing can be further processed to provide a simple but solid connection with fan rotor body that is suitable for mass production of embedded injection molding of fan rotor body.

The third preferred embodiment of the present invention comprising a pair of ceramic hollow tube shape bearings, a ceramic hollow axle tube and a ceramic holding ring. The bearings pass through and fix on rotor upper body and rotor lower body respectively and rotate with the rotor. The axle tube is a cylindrical hollow tube, which passes through the inside of both bearings and connects the center of front and rear fan body support frame. The axle tube does not rotate and work as structural support to provide multi-point contact rotating support mechanism. The ceramic holding ring has an opening gap and is installed at both ends of axle tube to limit the axial movement of axle tube. As stated in the first preferred embodiment of present invention, the interior of bearing and exterior of axle tube can be further processed to reduce surface contact and friction and the exterior of bearing can be further processed to provide a simple but solid connection with fan rotor body that is suitable for mass production of embedded injection molding of fan rotor body.

The axle tube is fixed and connecting the center of front and rear fan body support frame while fan coil/electronic control circuit board is fixed on the axle tube and external power source is connected thru an opening slot on axle tube. The rotor upper and lower bodies form a closed area to contain the rotation

support structure of heat-dissipation fan and fan coil/electronic control circuit board, preventing dust and particles accumulation. The present invention is very useful for high contamination and hostile environment.

The above and other objects, feature and advantages of the present invention will become clear from the following description based upon the accompanying drawings, which illustrate examples of preferred embodiment of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG.1 is an exploded view of prior art heat-dissipation fan.

FIG.2 is exploded view of present invention.

FIG.3a shows the cross sectional view of axle tube.

FIG.3b shows the bottom view of axle tube.

FIG.3c shows the top view of axle tube.

FIG.4a shows cross sectional view of bearing and support bearing.

FIG.4b shows top view of bearing and support bearing.

FIG.4c shows cross sectional view of embedded ceramic bearing in injection molding of fan rotor.

FIG.5 shows cross sectional view of the first preferred embodiment of the present invention.

FIG.6 shows cross sectional view of the second preferred embodiment of the present invention.

FIG.7 shows cross sectional view of the third preferred embodiment of the

present invention.

FIG.8 shows front and rear view of fan body in the third preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG.2 is the exploded view of present invention. The ceramic hollow tube bearing 2 passes through and fixes on fan rotor 100 and rotating with the rotor. The ceramic hollow tube support bearing 4 passes thru and fixes on fan base 107. The axle tube 6 is cylindrical shape or with an end flange portion forming a T shape tube, which passes through the inside of bearing 2 and support bearing 4 and rotate asynchronously and slowly with rotor 100. The ceramic holding ring 8 has an opening gap and is installed at one end of axle tube to limit the axial movement of axle tube.

When the fan is energized and in rotation, the bearing 2 is rotating with the rotor 100 and the axle tube 6 will be carried forward asynchronously and rotating slowly within the bearing 2 and support bearing 4. Since the bearing 2 and axle tube 6 are rotating at different speeds in the same direction, it will greatly reduce friction and increase fan speed and efficiency. To avoid axial direction movement of axle tube, a ceramic holding ring 8 is installed at the end of axle tube. Rotating bearing 2, fixed support bearing 4, free moving axle tube 6 and auto balancing of magnetic force will create a stable high speed multi-point contact rotating mechanism with minimum vibration and friction.

FIG.3a, FIG.3b, FIG.3c shows the cross sectional, bottom and top view of

axle tube 6 respectively. The exterior of axle tube 6 is formed or ground with concave grooves or with non-circular shape to reduce surface contact thereof friction between bearing 2, support bearing 4 and axle tube 6.

FIG.4a, FIG.4b shows cross sectional and top view of bearing 2 and support bearing 4 respectively. The exterior of bearing 2 and support bearing 6 are formed or ground to concave surface with smaller outer diameter or non-circular shape or concave groove shape to provide a solid connection with fan rotor 100. The interior of bearing 2 and support bearing 4 are formed or ground with concave grooves to reduce surface contact thereof friction among bearing 2, support bearing 4 and axle tube 6.

FIG.4c shows cross sectional view of embedded ceramic bearing 2 in injection molding of fan rotor 100. The exterior of bearing 2 and support bearing 6 are formed or ground to concave surface with smaller outer diameter or non-circular shape or concave groove shape to provide a solid connection with fan rotor 100. The present invention is very useful in producing small and thin rotor fan.

FIG.5 shows cross sectional view of the first preferred embodiment of the present invention comprising a ceramic hollow tube shape bearing 2, support bearing 4 and axle tube 6 and a ceramic holding ring 8. The bearing 2 passes through and fixes on fan rotor 100 and rotating with the rotor while the support bearing 4 fixes on fan base 107 and works as structural support which do not rotate. The axle tube 6 is cylindrical shape or with an end flange portion forming a T shape tube and the axle tube 6 pass through the inside of bearing 2 and

support bearing 4 and rotating asynchronously and freely with fan rotor 100. The axle tube 6 functions as structural support to provide multi-point contact rotating support mechanism. The ceramic holding ring 8 has an opening gap and is installed at one end of axle tube 6 to limit the axial movement of axle tube.

FIG.6 shows cross sectional view of the second preferred embodiment of the present invention comprising a ceramic hollow tube shape bearing 2 and axle tube 6 and a ceramic holding ring 8. The bearing 2 passes through and fixes on fan rotor 100 and rotating with the rotor. The axle tube 6 is cylindrical shape or with an end flange portion forming a T shape tube and the axle tube passes through the inside of bearing 2 and fixes on fan base 107 to provide structural support and multi-point contact rotating support mechanism. The ceramic holding ring 8 has an opening gap and is installed at one end of axle tube 6 to limit the axial movement of axle tube.

FIG.7 shows cross sectional view of the third preferred embodiment of the present invention comprising a pair of ceramic hollow tube shape bearings 202 and 204, a ceramic hollow axle tube 206 and a ceramic holding ring 208. The bearings 202, 204 pass through and fix on rotor upper body 210 and rotor lower body 212 respectively and rotating with the rotor. The axle tube 206 is a cylindrical hollow tube, which passes through the inside of both bearings 202, 204 and connects the center of front and rear fan body support frame 214, 216. The axle tube 206 does not rotate and work as structural support to provide multi-point contact rotating support mechanism. The ceramic holding ring 208 has an opening gap and is installed at both ends of axle tube to limit the axial

movement of axle tube.

The axle tube 206 is fixed and connecting the center of front and rear fan body support frame 214, 216 while fan coil/electronic control circuit board 218 is fixed on the axle tube 206 and external power source is connected thru an opening slot 220 on axle tube. The rotor upper body 210 and lower body 212 form a closed area to contain the rotation support structure of heat-dissipation fan and fan coil/electronic control circuit board 218, preventing dust and particles accumulation. The present invention is very useful for high contamination and hostile environment.

FIG.8 shows front and rear view of fan body in the third preferred embodiment of the present invention. The axle tube 206 passes through the inside of both bearings 202, 204 and connects the center of front and rear fan body support frame 214, 216.

There is no special restriction to the manufacturing process of hollow ceramic tube bearing 2, 202, 204, support bearing 4, hollow ceramic axle tube 6, 206 and ceramic holding ring 8, 208 of present invention. The preferred embodiments of the present invention are using metal oxide ceramic powders e.g. aluminum oxide, zirconium oxide, silicon oxide, etc., or a mixture of two or more oxides powder are used and formulated with binding material. After molding, ceramic green bodies are debinded in low temperature then sintered in high temperature to produce high mechanical strength and durable ceramic blanks. Ceramic blanks require further precision processes to become ceramic bearing 2, 202, 204, support bearing 4 and axle tube 6, 206. Precision grinding and

polishing then apply to ceramic blanks to achieve near true circular shape to maintain low vibration and low noise rotation. Ceramic holding rings 8, 208 are made from ceramic blanks by slicing ceramic blanks into circular rings then cutting an opening slot on each ring.

Therefore, compared with prior art, advances of the present invention may be concluded as follows:

1. The present invention provides an improved structure of rotation support of heat-dissipation fan by utilizing high mechanical strength and durable ceramic for bearing, support bearing and axle tube to replace high price ball bearing or low quality metal sleeve. In addition, various bearing and axle tube supporting structures are provided and interior and exterior surface of bearing and axle tube are further processed to lower rotational friction thereof resulting a new heat-dissipation fan with lower noise, lower power consumption, longer life and higher speed.
2. The present invention provides a very useful mass production method for small and thin rotor fan. The exterior surface of bearing and support bearing are formed or ground to concave surface with smaller outer diameter or non-circular shape or concave groove shape to provide a simple but solid connection with fan rotor body and is suitable for mass production of embedded injection molding of fan rotor body.
3. The third preferred embodiment of present invention provides a very useful solution for high contamination and hostile environment. The rotor upper and lower bodies form a closed area to contain the rotation support structure of

heat-dissipation fan and fan coil/electronic control circuit board, preventing dust and particles accumulation.

The present invention has been described using foregoing preferred embodiments. However, it is to be understood that the scope of the present invention is not limited to the disclosed embodiments. On the contrary, it is intended to cover various modifications and similar arrangements. The scope of the claims, therefore, should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.